II. *Monſieur* Caſſini *his New and Exact Tables for the* Eclipſes *of the Firſt* Satellite *of* Jupiter, *reduced to the* Julian *Stile, and Meridian of* London.

AMong the Books the *Royal Academy* of *Sciences* at *Paris* has lately gratified the World withal, there is one which has for Title, *Recueuil d'Obſervations faites en pluſieurs Voiages pour parfectionner l'Aſtronomie & la Geographie, Avec divers traitez Aſtronomiques.* In which thoſe *Sçavans* have ſet a very commendable Example in aſcertaining by undoubted Obſervations the true *Geographical Site* of all the Principal Ports of *France*, which it were to be wiſhed other Nations would imitate. By this Survey they have demonſtrated the Encroachments their *Geographers*, and particularly *Sanſon*, had made on the *Sea* to enlarge their *Kingdom*, and have retrenched more of their Uſurpations on the *Weſt*, *South*, and *North*, than all their *Acquiſts* on the *Eaſt* amount to twice told.

The Method they have uſed to determine the *Longitudes* of their Places, is by the Obſervation of the *Eclipſes* of the *Firſt Satellite* of *Jupiter*, which they find almoſt inſtantaneous, and with good Teleſcopes diſcernable almoſt to the very Oppoſition of *Jupiter* to the *Sun*: And it may be ſaid, that this Account of the *Longitudes* obſerved, has put it paſt doubt that this is the very beſt way, could portable Teleſcopes ſuffice for the Work. And could theſe *Satellites* be obſerved at *Sea*, a *Ship* at *Sea* might be enabled to find the Meridian ſhe was in, by help of the Tables Monſieur *Caſſini* has given us in this Volume, diſcovering with very great exactneſs the ſaid *Eclipſes*, beyond what we can yet hope to do by the *Moon*, tho' ſhe ſeem to afford us the only means Practicable for the *Seaman*. However before Saylors can make uſe of the Art of finding the *Longitude*, it will be requiſite that the Coaſt of the whole Ocean be firſt laid down truly, for which work this Method by the *Satellites* is moſt appoſite: And it may be hoped that either the true Geometrick Theory of the *Moon* may be diſcovered, by the time the Charts are compleated; or elſe that ſome Invention of ſhorter Teleſcopes manageable on Ship-board, may ſuffice to ſhew the *Eclipſes* of the *Satellites* at Sea, at leaſt thoſe of the Third *Satellite*, which fall at a good diſtance from the Body of *Jupiter*, being near three times as far from him as the firſt.

The laſt but moſt conſiderable Treatiſe of this Collection gives the aforeſaid Tables for computing the Motions of *Jupiter's Satellites*, but more eſpecially thoſe, for ſpeedy finding the Eclipſes of the firſt or innermoſt. Wherein Monſieur *Caſſini* has employed his Skill to make eaſie and obvious to all Capacities the Calculation of them, which is otherwiſe operoſe to the Skilful, and not to be undertaken by the leſs knowing, who yet perhaps would be willing to find the Longitude of the Places they live in.

Theſe Tables have for Principles, That the innermoſt *Satellite* revolves to the Sun in $1^{d.}\ 18^{h.}\ 28'.\ 36''$. ſo preciſely, that in 100 Years the difference is not ſenſible; That in the time of the Revolution of *Jupiter* to his *Aphelion*, which he ſuppoſes in $4332^{d.}\ 14^{h.}\ 52'.\ 48''$, this *Satellite* makes exactly 2448 Months or Revolutions to the Sun: and dividing the Orbite of *Jupiter* into 2448 parts, he has in a large Table of Æquation ſhewn what is the inequality of the Motion of *Jupiter* in each Revolution reduced to Time, aſſuming *Thirdly*, the greateſt Æquation of *Jupiter* $5^{o.}\ 30'$. whence the hourly Motion of the *Satellite* from *Jupiter* being $8^{o.}\ 26'\frac{1}{4}$, it follows, that the greateſt inequality (*Jupiter* paſſing the Signs of *Cancer* and *Capricorn*,) amounts to $39'.\ 8''$. of time, to be added in *Cancer*, ſubſtracted in *Capricorn*. *Laſtly*, As to the *Epocha* or beginning of this Series of Revolutions, he has determined the *Aphelion* of *Jupiter* about 1½ Degree forwarder than *Aſtronomia Carolina*, and above 2 Degrees more than the *Rudolphine Tables*, *viz.* preciſely in $9^{o.}$ of *Libra*, in the beginning of this Century, which perhaps he finds the proper Motion of *Jupiter* about the Sun at this time to require; and the number of Revolutions ſince *Jupiter* was laſt in *Perihelio*, is here ſtiled *Num.* I.

A

A ſecond Inequality is that which depends on the diſtance of the Sun from *Jupiter*, which he ſays Monſieur *Romer* did moſt ingeniouſly explain by the Hypotheſis of the Motion of Light; to which yet *Caſſini* by his manner of *Calculus* ſeems not to aſſent, though it be hard to imagine how the Earth's Poſition in reſpect of *Jupiter* ſhould any way affect the Motion of the *Satellites*. This Inequality he makes to amount to two Degrees in the *Satellites* Motion, or 14'. 10". of Time, wherein he ſuppoſes the Eclipſes to happen ſo much ſooner when *Jupiter* Oppoſes the Sun, than when he is in Conjunction with him. The diſtribution of this Inequality he makes wholly to depend on the Angle at the Sun between the Earth and *Jupiter*, without any regard to the Excentricity of *Jupiter*, (who is ſometimes ½ a Semi-diameter of the Earth's Orb farther from the Sun than at other times) which would occaſion a much greater difference than the Inequality of *Jupiter* and the *Earth's* Motion, both of which are accounted for in theſe Tables with great Skill and Addreſs. But what is moſt ſtrange, he affirms that the ſame Inequality of two Degrees in the Motion, is likewiſe found in the other *Satellites*, requiring a much greater time, as above two Hours in the fourth *Satellite*: which if it appeared by Obſervation, would overthrow Monſieur *Romer*'s Hypotheſis entirely. Yet I doubt not herein to make it demonſtratively plain, that the Hypotheſis of the progreſſive Motion of Light is found in all the other *Satellites* of *Jupiter* to be neceſſary, and that it is the ſame in all; there being nothing near ſo great an Annual Inequality as Monſieur *Caſſini* ſuppoſes in their Motions, by his Table, *pag.* 9. and his *Præcepta Calculi*. The Method however uſed to compute this is very Curious; for having found that whilſt the Sun revolves to *Jupiter*, there paſs 398d. 21h. 13'. wherein are made 225⅜ Revolutions of the *Satellite* to *Jupiter*, the Number of Revolutions ſince *Jupiter* was laſt in Oppoſition to the Sun, is what he calls *Num.* II. in which the Inequality of the Earth's Motion is allowed for in the Months, and that of *Jupiter*'s Orb by a Table of the Æquation of *Num.* II. amounting in all to 3½ Revolutions of the *Satellite* to *Jupiter*. This in the Tables following I have thought fit to leave out, ſhewing how to find it by help of the former Æquation of *Num.* I. The Numbers are in effect the ſame with Monſieur *Caſſini*'s, only reduced to our Stile and Meridian, and the form of them abridged, and 'tis hoped amended. *See* Philoſ. Tranſact. No. 136.

Epochæ Revolutionum primi Satellitis *ad* Jovis *Umbram ſub Meridiano* Londinenſi.

Anno Jul. Curr.	D.	h.	'	''	Num. I.	Num. II.	Anno Jul. Curr.	D.	h.	'	''	Num. I.	Num. II.
1660	0	11	5	48	968	200,6	1690	0	16	8	24	2263	81,0
61	0	1	17	24	1174	181,2	91	0	6	20	0	21	61,6
62	1	9	57	36	1381	162,9	92	0	15	0	12	228	43,3
63	1	0	9	12	1587	143,5	93	0	5	11	48	434	23,9
1664	1	8	49	24	1794	125,1	94	1	13	52	0	641	5,5
65	0	23	1	0	2000	105,7	1695	1	4	3	36	847	211,5
66	0	13	12	36	2206	86,4	96	1	12	43	48	1054	193,1
67	0	3	24	12	2412	67,0	97	1	2	55	24	1260	173,7
68	0	12	4	24	171	48,6	98	0	17	7	0	1466	154,4
1669	0	2	16	0	377	29,2	99	0	7	18	36	1672	135,0
70	1	10	56	12	584	10,9	1700	0	15	58	48	1879	116,6
71	1	1	7	48	790	216,9	01	0	6	10	24	2085	97,3
72	1	9	48	0	997	198,5	02	1	14	50	36	2292	78,9
73	0	23	59	36	1203	179,1	03	1	5	2	12	50	59,5
1674	0	14	11	12	1409	159,7	04	1	13	42	24	257	41,1
75	0	4	22	48	1615	140,3	1705	1	3	54	0	463	21,8
76	0	13	3	0	1822	121,9	06	0	18	5	36	669	2,4
77	0	3	14	36	2028	102,5	07	0	8	17	12	875	208,4
78	1	11	54	48	2235	84,1	08	0	16	57	24	1082	190,0
1679	1	2	6	24	2441	64,7	09	0	7	9	0	1288	170,6
80	1	10	46	36	200	46,4	1710	1	15	49	12	1495	152,3
81	1	0	58	12	406	27,0	11	1	6	0	48	1701	132,9
82	0	15	9	48	612	7,6	12	1	14	41	0	1908	114,5
83	0	5	21	24	818	213,6	13	1	4	52	36	2114	95,1
1684	0	14	1	36	1025	195,3	14	0	19	4	12	2320	75,8
85	0	4	13	12	1231	175,9	1715	0	9	15	48	78	56,4
86	1	12	53	24	1438	157,5	16	0	17	56	0	285	38,0
87	1	3	5	0	1644	138,1	17	0	8	7	36	491	18,6
88	1	11	45	12	1851	119,7	18	1	16	47	48	698	0,3
1689	1	1	56	48	2057	100,4	19	1	6	59	24	904	206,3
							1720	1	15	39	36	1111	187,9

Tabula Revolutionum primi Satellitis Jovis *in Anno.*

Januarius.				Num. I.	Num. II.
D.	h.	′	″		
0	0	0	0	0	0,0
1	18	28	36	1	1,0
3	12	57	12	2	2,1
5	7	25	48	3	3,1
7	1	54	24	4	4,1
8	20	23	0	5	5,2
10	14	51	36	6	6,2
12	9	20	12	7	7,2
14	3	48	48	8	8,2
15	22	17	24	9	9,3
17	16	46	0	10	10,3
19	11	14	36	11	11,3
21	5	43	12	12	12,3
23	0	11	48	13	13,4
24	18	40	24	14	14,4
26	13	9	0	15	15,4
28	7	37	36	16	16,5
30	2	6	12	17	17,5
31	20	34	48	18	18,5
Februarius.					
0	20	34	48	18	18,5
2	15	3	24	19	19,6
4	9	32	0	20	20,6
6	4	0	36	21	21,6
7	22	29	12	22	22,6
9	16	57	48	23	23,7
11	11	26	24	24	24,7
13	5	55	0	25	25,7

Februarius.				Num. I.	Num. II.
D.	h.	′	″		
13	5	55	0	25	25,7
15	0	23	36	26	26,7
16	18	52	12	27	27,7
18	13	20	48	28	28,7
20	7	49	24	29	29,7
22	2	18	0	30	30,8
23	20	46	36	31	31,8
25	15	15	12	32	32,8
27	9	43	48	33	33,8
Martius.					
1	4	12	24	34	34,8
2	22	41	0	35	35,8
4	17	9	36	36	36,8
6	11	38	12	37	37,9
8	6	6	48	38	38,9
10	0	35	24	39	39,9
11	19	4	0	40	40,9
13	13	32	36	41	41,9
15	8	1	12	42	42,9
17	2	29	48	43	43,9
18	20	58	24	44	44,9
20	15	27	0	45	45,9
22	9	55	36	46	46,9
24	4	24	12	47	47,9
25	22	52	48	48	48,9
27	17	21	24	49	49,9
29	11	50	0	50	50,9
31	6	18	36	51	51,9

Tabula Revolutionum primi Satellitis Jovis *in Anno.*

D.	h.	′	″	Num. I	Num. II
Aprilis.					
0	6	18	36	51	51,9
2	0	47	12	52	52,9
3	19	15	48	53	53,9
5	13	44	24	54	54,9
7	8	13	0	55	55,9
9	2	41	36	56	56,9
10	21	10	12	57	57,9
12	15	38	48	58	58,9
14	10	7	24	59	59,9
16	4	36	0	60	60,8
17	23	4	36	61	61,8
19	17	33	12	62	62,8
21	12	1	48	63	63,8
23	6	30	24	64	64,8
25	0	59	0	65	65,7
26	19	27	36	66	66,7
28	13	56	12	67	67,7
30	8	24	48	68	68,6
Maius.					
0	8	24	48	68	68,6
2	2	53	24	69	69,6
3	21	22	0	70	70,6
5	15	50	36	71	71,6
7	10	19	12	72	72,5
9	4	47	48	73	73,5
10	23	16	24	74	74,5
12	17	45	0	75	75,5
14	12	13	36	76	76,4

D	h.	′	″	Num. I	Num. II
Maius.					
14	12	13	36	76	76,4
16	6	42	12	77	77,4
18	1	10	48	78	78,4
19	19	39	24	79	79,3
21	14	8	0	80	80,3
23	8	36	36	81	81,3
25	3	5	12	82	82,3
26	21	33	48	83	83,3
28	16	2	24	84	84,2
30	10	31	0	85	85,2
Junius.					
1	4	59	36	86	86,1
2	23	28	12	87	87,1
4	17	56	48	88	88,0
6	12	25	24	89	89,0
8	6	54	0	90	90,0
10	1	22	36	91	90,9
11	19	51	12	92	91,9
13	14	19	48	93	92,9
15	8	48	24	94	93,8
17	3	17	0	95	94,8
18	21	45	36	96	95,7
20	16	14	12	97	96,7
22	10	42	48	98	97,7
24	5	11	24	99	98,6
25	23	40	0	100	99,6
27	18	8	36	101	100,6
29	12	37	12	102	101,5

Tabula Revolutionum primi Satellitis Jovis *in Anno.*

D.	h.	′	″	Num. I.	Num. II.
Julius.					
1	7	5	48	103	102,5
3	1	34	24	104	103,5
4	20	3	0	105	104,4
6	14	31	36	106	105,4
8	9	0	12	107	106,4
10	3	28	48	108	107,3
11	21	57	24	109	108,3
13	16	26	0	110	109,3
15	10	54	36	111	110,2
17	5	23	12	112	111,2
18	23	51	48	113	112,2
20	18	20	24	114	113,1
22	12	49	0	115	114,1
24	7	17	36	116	115,1
26	1	46	12	117	116,0
27	20	14	48	118	117,0
29	14	43	24	119	118,0
31	9	12	0	120	119,0
Augustus.					
0	9	12	0	120	119,0
2	3	40	36	121	119,9
3	22	9	12	122	120,9
5	16	37	48	123	121,9
7	11	6	24	124	122,[illegible]
9	5	35	0	12[illegible]	123,[illegible]
11	0	3	36	1[illegible]6	12[illegible]
12	18	32	12	127	12[illegible]
14	13	0	48	128	126,[illegible]

D.	h.	′	″	Num. I.	Num. II.
Augustus.					
14	13	0	48	128	126,8
16	7	29	24	129	127,7
18	1	58	0	130	128,7
19	20	26	36	131	129,7
21	14	55	12	132	130,7
23	9	23	48	133	131,7
25	3	52	24	134	132,7
26	22	21	0	135	133,6
28	16	49	36	136	134,6
30	11	18	12	137	135,6
September.					
1	5	46	48	138	136,6
3	0	15	24	139	137,6
4	18	44	0	140	138,6
6	13	12	36	141	139,6
8	7	41	12	142	140,6
10	2	9	48	143	141,5
11	20	38	24	144	142,5
13	15	7	0	145	143,5
15	9	35	36	146	144,5
17	4	4	12	147	145,5
18	22	32	48	148	146,5
20	17	1	24	149	147,5
22	11	30	0	150	148,5
24	5	58	36	151	149,5
26	0	27	12	152	150,5
27	18	55	48	153	15[illegible],5
29	13	24	24	154	15[illegible],5

Tabula Revolutionum primi Satellitis Jovis *in Anno.*

D.	h.	′	″	Num. I.	Num. II.
October.					
1	7	53	0	155	153,5
3	2	21	36	156	154,5
4	20	50	12	157	155,5
6	15	18	48	158	156,5
8	9	47	24	159	157,5
10	4	16	0	160	158,5
11	22	44	36	161	159,5
13	17	13	12	162	160,5
15	11	41	48	163	161,6
17	6	10	24	164	162,6
19	0	39	0	165	163,6
20	19	7	36	166	164,6
22	13	36	12	167	165,6
24	8	4	48	168	166,6
26	2	33	24	169	167,7
27	21	2	0	170	168,7
29	15	30	36	171	169,7
31	9	59	12	172	170,7
November.					
0	9	59	12	172	170,7
2	4	27	48	173	171,8
3	22	56	24	174	172,8
5	17	25	0	175	173,8
7	11	53	36	176	174,8
9	6	22	12	177	175,9
11	0	50	48	178	176,9
12	19	19	24	179	177,9
14	13	48	0	180	178,9
16	8	16	36	181	180,0

D.	h.	′	″	Num. I.	Num. II.
November.					
16	8	16	36	181	180,0
18	2	45	12	182	181,0
19	21	13	48	183	182,0
21	15	42	24	184	183,0
23	10	11	0	185	184,0
25	4	39	36	186	185,1
26	23	8	12	187	186,1
28	17	36	48	188	187,2
30	12	5	24	189	188,2
December.					
0	12	5	24	189	188,2
2	6	34	0	190	189,2
4	1	2	36	191	190,3
5	19	31	12	192	191,3
7	13	59	48	193	192,3
9	8	28	24	194	193,4
11	2	57	0	195	194,4
12	21	25	36	196	195,5
14	15	54	12	197	196,5
16	10	22	48	198	197,6
18	4	51	24	199	198,6
19	23	20	0	200	199,7
21	17	48	36	201	200,7
23	12	17	12	202	201,8
25	6	45	48	203	202,8
27	1	14	24	204	203,9
28	19	43	0	205	204,9
30	14	11	36	206	206,0

Tabula Primæ Æquationis Conjunctionum primi Satellitis *cum* Jove.

Num. I.	Æquat. ′	″	Num. I.	Æquat. ′	″	Num. I.	Æquat. ′	″	Num. I.	Æquat. ′	″
0	0	0	300	28	9	610	39	5	920	26	37
10	1	3	310	28	54	620	39	3	930	25	53
20	2	5	320	29	35	630	38	58	940	25	8
30	3	8	330	30	11	640	38	51	950	24	23
40	4	12	340	30	45	650	38	44	960	23	37
50	5	15	350	31	28	660	38	34	970	22	50
60	6	16	360	32	10	670	38	24	980	22	3
70	7	19	370	32	44	680	38	10	990	21	15
80	8	20	380	33	15	690	37	56	1000	20	26
90	9	23	390	33	49	700	37	40	1010	19	37
100	10	25	400	34	20	710	37	24	1020	18	47
110	11	25	410	34	51	720	37	5	1030	17	56
120	12	25	420	35	21	730	36	45	1040	17	5
130	13	25	430	35	47	740	36	25	1050	16	13
140	14	25	440	36	6	750	36	4	1060	15	19
150	15	22	450	36	26	760	35	40	1070	14	25
160	16	18	460	36	47	770	35	15	1080	13	32
170	17	17	470	37	8	780	34	49	1090	12	37
180	18	11	480	37	29	790	34	19	1100	11	42
190	19	9	490	37	44	800	33	49	1110	10	47
200	20	5	500	37	59	810	33	21	1120	9	52
210	20	56	510	38	16	820	32	50	1130	8	57
220	21	49	520	38	29	830	32	17	1140	8	0
230	22	41	530	38	39	840	31	44	1150	7	3
240	23	32	540	38	49	850	31	10	1160	6	7
250	24	20	550	38	55	860	30	32	1170	5	10
260	25	7	560	38	59	870	29	56	1180	4	13
270	25	57	570	39	3	880	29	19	1190	3	15
280	26	43	580	39	6	890	28	40	1200	2	19
290	27	27	590	39	8	900	27	59	1210	1	21
300	28	9	600	39	7	910	27	19	1220	0	24
			610	39	5	920	26	37	1224	0	0

Tabula Secundæ Æquationis Conjunctionum primi Satellitis *cum* Jove.

Num. II.	Æquat. add.		Num. II.	Æquat. add.		Num. II.	Æquat. add.		Num. II.	Æquat. add.	
0	0′	0″	28	2′	4″	56	7′	0″	84	12′	0″
1	0	0	29	2	13	57	7	12	85	12	9
2	0	1	30	2	21	58	7	24	86	12	16
3	0	2	31	2	30	59	7	36	87	12	24
4	0	3	32	2	39	60	7	47	88	12	32
5	0	4	33	2	48	61	7	59	89	12	40
6	0	6	34	2	58	62	8	11	90	12	47
7	0	8	35	3	8	63	8	22	91	12	53
8	0	10	36	3	17	64	8	34	92	13	0
9	0	14	37	3	27	65	8	46	93	13	6
10	0	17	38	3	37	66	8	57	94	13	13
11	0	20	39	3	48	67	9	8	95	13	19
12	0	23	40	3	59	68	9	20	96	13	24
13	0	27	41	4	9	69	9	32	97	13	30
14	0	32	42	4	20	70	9	44	98	13	35
15	0	37	43	4	31	71	9	54	99	13	39
16	0	42	44	4	41	72	10	3	100	13	45
17	0	47	45	4	53	73	10	14	101	13	48
18	0	53	46	5	4	74	10	25	102	13	51
19	0	58	47	5	15	75	10	35	103	13	54
20	1	4	48	5	27	76	10	45	104	13	57
21	1	11	49	5	39	77	10	55	105	14	0
22	1	18	50	5	50	78	11	5	106	14	3
23	1	25	51	6	2	79	11	15	107	14	5
24	1	32	52	6	14	80	11	25	108	14	7
25	1	40	53	6	25	81	11	34	109	14	8
26	1	47	54	6	37	82	11	43	110	14	9
27	1	56	55	6	49	83	11	52	111	14	10
28	2	4	56	7	0	84	12	0	112	14	10

Tabula Dimidiæ Moræ primi Satellitis *in Umbra* Jovis.

Num.I.	H.	'	"	Num.I.	H.	'	"
0	1	4	56	1200	1	5	6
40	1	4	33	1240	1	4	48
80	1	4	12	1280	1	4	26
120	1	3	59	1320	1	4	7
160	1	3	48	1360	1	3	54
200	1	3	39	1400	1	3	38
240	1	3	38	1440	1	3	38
280	1	3	48	1480	1	3	44
320	1	4	1	1520	1	3	52
360	1	4	16	1560	1	4	7
400	1	4	36	1600	1	4	24
440	1	4	56	1640	1	4	42
480	1	5	18	1680	1	5	0
520	1	5	41	1720	1	5	22
560	1	6	1	1760	1	5	46
600	1	6	21	1800	1	6	10
640	1	6	39	1840	1	6	28
680	1	6	53	1880	1	6	45
720	1	7	3	1920	1	6	57
760	1	7	11	1960	1	7	7
800	1	7	15	2000	1	7	13
840	1	7	13	2040	1	7	14
880	1	7	9	2080	1	7	15
920	1	7	2	2120	1	7	15
960	1	6	54	2160	1	7	10
1000	1	6	39	2200	1	6	49
1040	1	6	22	2240	1	6	32
1080	1	6	5	2280	1	6	15
1120	1	5	45	2320	1	5	58
1160	1	5	26	2360	1	5	38
1200	1	5	6	2400	1	5	18
				2440	1	5	2

TABULA ÆQUATIONIS DIERUM
cum Solis loco adeunda.

	♈		♉		♊		♋		♌		♍	
G.	′ S	″	′ A	″	′ A	″	′ S	″	′ S	″	′ S	″
0	7	45	1	11	4	3	0	59	5	43	2	8
1	7	26	1	24	4	0	1	15	5	45	1	53
2	7	7	1	37	3	56	1	29	5	46	1	37
3	6	48	1	49	3	51	1	42	5	47	1	21
4	6	29	2	1	3	45	1	54	5	48	1	5
5	6	10	2	12	3	39	2	6	5	48	0	48
6	5	51	2	23	3	32	2	19	5	48	0	30
7	5	31	2	33	3	25	2	32	5	46	0	12
8	5	11	2	43	3	17	2	44	5	44	0	A 7
9	4	51	2	53	3	9	2	56	5	40	0	26
10	4	31	3	3	3	0	3	8	5	36	0	45
11	4	11	3	13	2	51	3	20	5	31	1	3
12	3	52	3	22	2	41	3	32	5	25	1	21
13	3	33	3	30	2	31	3	43	5	19	1	40
14	3	14	3	37	2	21	3	54	5	13	1	59
15	2	55	3	43	2	10	4	4	5	6	2	19
16	2	37	3	48	2	0	4	14	4	58	2	40
17	2	19	3	53	1	49	4	24	4	49	3	1
18	2	1	3	57	1	37	4	34	4	39	3	22
19	1	43	4	1	1	25	4	43	4	30	3	44
20	1	26	4	5	1	13	4	51	4	20	4	6
21	1	9	4	8	1	1	4	59	4	9	4	29
22	0	52	4	10	0	49	5	6	3	57	4	51
23	0	35	4	12	0	37	5	13	3	45	5	13
24	0	19	4	13	0	24	5	19	3	32	5	35
25	0	3	4	11	0	10	5	24	3	19	5	57
26	0	A 12	4	9	0	S 3	5	29	3	5	6	19
27	0	27	4	8	0	16	5	33	2	51	6	41
28	0	42	4	6	0	29	5	37	2	37	7	2
29	0	57	4	5	0	44	5	40	2	23	7	22
30	1	11	4	3	0	59	5	43	2	8	7	44

TABUL

TABULA ÆQUATIONIS DIERUM.

	♎		♏		♐		♑		♒		♓	
G.	′ A	″	′ A	″	′ A	″	′ A	″	′ S	″	′ S	″
0	7	44	15	34	13	25	0	59	11	48	14	36
1	8	5	15	42	13	7	0	27	12	4	14	29
2	8	25	15	48	12	48	0	S 5	12	19	14	21
3	8	45	15	53	12	29	0	35	12	35	14	13
4	9	5	15	57	12	10	1	4	12	50	14	4
5	9	25	16	1	11	50	1	33	13	5	13	55
6	9	44	16	5	11	30	2	3	13	19	13	46
7	10	3	16	7	11	10	2	32	13	32	13	37
8	10	22	16	8	10	49	3	1	13	44	13	27
9	10	41	16	9	10	28	3	29	13	55	13	17
10	11	0	16	9	10	6	3	57	14	5	13	7
11	11	19	16	9	9	42	4	25	14	14	12	56
12	11	38	16	8	9	17	4	53	14	22	12	44
13	11	57	16	7	8	51	5	20	14	29	12	32
14	12	15	19	5	8	25	5	48	14	35	12	19
15	12	33	16	1	7	58	6	15	14	40	12	6
16	12	50	15	56	7	31	6	42	14	45	11	52
17	13	7	15	50	7	5	7	9	14	50	11	37
18	13	22	15	44	6	38	7	34	14	54	11	21
19	13	36	15	37	6	12	7	58	14	56	11	4
20	13	49	15	30	5	45	8	21	14	58	10	46
21	14	2	15	22	5	19	8	45	14	59	10	28
22	14	14	15	13	4	52	9	8	15	0	10	10
23	14	26	15	3	4	26	9	31	15	0	9	52
24	14	37	14	52	3	58	9	53	15	0	9	34
25	14	47	14	40	3	30	10	13	14	58	9	16
26	14	57	14	27	3	1	10	32	14	55	8	58
27	15	7	14	13	2	31	10	51	14	51	8	40
28	15	16	13	58	2	1	11	10	14	47	8	22
29	15	25	13	42	1	30	11	29	14	42	8	4
30	15	34	13	25	0	59	11	48	14	36	7	45

This

This laſt Table of the Æquation of Natural Days might have been ſpared, as being publiſht in ſeveral other places, but it was thought proper to have all the *Elements* of this *Calculus* together, that there might be no occaſion of any other Book to perform it.

The Uſe of the Tables.

To any given Year, Month, and Day, to find the next Eclipſe of the firſt Satellite *of* Jupiter.

I. In the Table of *Epochæ* (*pag.* 240.) find the Year of our Lord, and ſet down the Day, Hours, Minutes, and Seconds, with the Num. I. and Num. II. thereto annext; and (in *pag.* 241 and the following) ſeek the Month, and day of the Month, with the Hours and Minutes, and Num. I. and II. affixt, and add them together: and the reſpective Sums ſhall ſhew the mean time of the middle of the Eclipſe ſought, with Num. I. and Num. II. required. But it muſt be obſerved, that in *January* and *February* in the Leap-Year one Day is to be added to the Day thus found.

II. If Num. I. be found leſs than 1224 with Num. I; or if greater than 2448, Subſtracting 2448 therefrom, with the reſidue, enter the Table, *pag.* 245. and you will have the firſt Æquation to be *added* to the mean Time before found. But if Num. I. be leſs than 2448, but greater than 1224, Subſtract it from 2448, and entring the ſame Table with the remainder, you ſhall have the firſt Æquation to be *ſubſtracted* from the mean Time. Then Divide the Minutes of the ſaid firſt Æquation by 11, or rather $\frac{34}{3}$, and the *Quote* ſhall be the Æquation of Num. II. (anſwering to the Eccentrick Motion of *Jupiter*) to be *added* thereto when the firſt Æquation *Subſtracts*, and *è contra ſubſtracted* when that *adds*.

III. If Num. II. thus æquated exceed 225,4, Subſtract 225,4 therefrom; and if the remainder or Num. II. be leſs than 113, with the ſaid remainder or Number; or if greater than 113, with the complement thereof to 225,4. ſeek in Table *pag.* 246. the ſecond Æquation, which being added to the Time before found, gives the true Time of the middle of the Eclipſe.

IV. With Num. I. in *Tab. pag.* 247, ſeek the half Continuance of the Total Eclipſe, which is to be added for the *Emerſion* when the æquated Num. II. is leſs than 113, or if more than 225,4, it be leſs than 338. But if it exceed 113 or 338, then is the *Semimora* to be ſubſtracted for the *Immerſion*.

V. Laſtly, with the Sun's true Place take out the Æquation of Natural Days (in *Tab. pag.* 248.) which added or ſubſtracted according to the Title, gives the time of the *Immerſion* or *Emerſion* ſought.

Now how few Figures ſerve for this Computation, will beſt appear by an Example or two.

Anno 1677. *September* $17^{th.}$ $8^{h.}$ $9'$. $40''$. at *Greenwich*, Mr. *Flamſteed* obſerved the firſt *Satellite* to begin to *Emerge*; that is $8^{h.}$ $9'$. $20''$. at *London*.

					Num. I.	Num. II.
1677.	$0^{d.}$	$3^{h.}$	$14'$	$36''$	2028	102,5
Sept.	17	4	4	12	147	145,5
Sept.	17	7	18	48	2175	248,0
Æquat. 1.	—		26	11	2448	2,3 +
	17	6	52	37	273	250,3
Æquat. 2.	+		1	39		225,4
Semimora	+	1	7	0		24,9
Equal Time	17	8	1	16	11)26,2(2,3+	
Æquation	+		9	25	☉ in ♎ 5,00	
Appar. T.	17	8	10	41		
Obſer.		8	9	20		
Error	—		1	21		

Again, *Anno* 1683. *November* 30th. 16h. 48′. 40″ under the Meridian of *London*, the *Immerſion* of this *Satellite* was obſerved by *E. Halley*.

						Num. I.	Num. II.
1683.	0d.	5h.	21′	24″		818	213,6
Novemb.	30	12	5	24		189	188,2
Novemb.	30	17	26	48		1007	401,8
Æquat. 1.	+		19	52			1,8 —
Æquat. 2.	+		6	0	11)20(1,8—		400,0
Novemb.	30	17	52	40			225,4
Semimora	—	1	6	36			174,6
Temp.æquat.	30	16	46	4			50,8
Æquat. T.	+		6	3	☉ in ♐ 19°. 20′		
Novemb.	30	16	52	7	Temp. appar.		
Obſer.		16	48	40			
Error		—	3	27			

A Third Example ſhall be the *Emerſion* obſerved at *Paris* by Monſieur *Caſſini Anno* 1693. *January* 14th. 10h. 40′. 28″. that is, at *London* at 10h. 30′. 48″.

						Num. I.	Num. II.
1693.	0d.	5h.	11′	48″		434	23,9
Jan.	14	3	48	48		8	8,2
Æquat. 1.	+		36	8		442	32,1
Æquat. 2.	+		2	13			3,2 —
Semimora	+	1	4	57	11)36,(3,2—		28,9
Temp.æquat.	14	10	43	54			
Æquat.	—		13	15	☉ in ♒ 5°. 40′.		
Januarii	14	10	30	39	Temp. app.		
Obſer.		10	30	48			
Error		+	0	9			

After this manner I have compared theſe Tables with many good and certain Obſervations, and ſcarce ever find them err above three or four Minutes of Time; which proceeds, as may well be conjectured, from ſome

ſmall

ſmall Eccentricity in its Motion, and from the *Oval* Figure of *Jupiter*'s Body, whoſe quick diurnal Rotation has by its *Vis Centrifuga* dilated his Equinoctial, and made his *Meridians* much *Elliptical*, ſo as to be diſcernable by the Teleſcope. Mr. *Newton* has ſhewn that his Polar Diameter is to that of his Equinoctial as 40 to 41 nearly. But we may hope future Obſervations may ſhew how to divide thoſe compounded cauſes of Error, and correct them; which Errors are exceeding ſmall in compariſon of the ſhort time that the *Satellites* have been diſcovered, and argue the Skill and Diligence of the deſervedly Famous Author of theſe *Tables*.

I had almoſt forgot the Conſtruction of the Table, *pag.* 247. ſhewing the half continuance of theſe Eclipſes: In this the Semidiameter of the ſhadow of *Jupiter* is made by *Caſſini* juſt 10 Degrees, and that of the *Satellite* 30′; and the *Satellites* Aſcending Node being ſuppoſed in 15°. of *Aquarius*, at the end of this Century, (that is, 55°. 20′. before the *Perihelion* of *Jupiter*) it will thence follow, that Num. I. being 816 or 2102, *Jupiter* paſſes the *Nodes* of the *Satellites* Orb, and conſequently theſe Eclipſes are Central, and of the greateſt Duration. But Num. I. being 215 or 1481, the *Satellite* paſſes the ſhadow with the greateſt Obliquity, *viz.* 2°. 55′ from the Center, whence the *Semimora* becomes of all the ſhorteſt. This Table is not however ſo nicely computed, but that it may admit of Correction in the Seconds, if a ſmall part of a Minute were conſiderable in this affair.

The Tables of the other *three Satellites* not being ſo perfect or exact as thoſe of the *firſt*, having greater inequalities, are here given in another form, requiring the aſſiſtance of the Tables of *Jupiter*'s proper motion. The Periods of their Revolutions to *Jupiter*'s ſhade are as follows:

Period. Secundi.	$3^{d.}$	$13^{h.}$	$17'.$	$54''.$	$3'''$	*ſive* $2\frac{1}{123}$ *Rev.primi.*
Period. Tertii.	7	3	59	39	22	*ſive* $4\frac{3}{21}$ *Rev.primi.*
Period. Quarti.	16	18	5	6	50	*ſive* $9\frac{7}{15}$ *Rev.primi.*

Whence the Table of the firſt Æquation of the *Firſt Satellite*, *pag.* 245, or Monſieur *Caſſini*'s larger Table, may by an caſie Reduction ſerve the other three; the Æquation of the *Second* being $2\frac{1}{123}$, or twice the Minutes with half ſo many Seconds as there are Minutes in the Æquation of the *Firſt*, and the greateſt Æquation thereof $1^{h.}$ 18'. 35''. The Æquation of the *Third* is $4\frac{1}{28}$ times greater than that of the *Firſt*, and when greateſt amounteth to $2^{h.}$ 38'. 29''. And the Æquation of the *Fourth* being $9\frac{7}{15}$ times that of the *Firſt*, is had by Subſtracting $\frac{1}{2}$ and $\frac{1}{30}$ from *ten times* the Æquation of the *Firſt*, whence the greateſt becomes $6^{h.}$ 10'. 28''. So that Num. I. and Num. II. as here collected for the *Firſt*, may indifferently ſerve all the reſt.

As to the Second Æquation of the other *Satellites*, Monſieur *Caſſini* has, by his *Præcepta Calculi* (as is before mentioned) ſuppoſed the Minutes thereof to be increaſed in the ſame proportion; as inſtead of 14'. 10''. in the *Firſt*, to be 28'. 27''. in the *Second*, 57'. 22''. in the *Third*, and no leſs than $2^{h.}$ 14'. 7''. in the *Fourth*; whereas if this ſecond Inequality did proceed from the ſucceſſive propagation of Light, this Æquation ought to be the ſame in all of them, which Monſieur *Caſſini* ſays was wanting to be ſhewn, to perfect Monſieur *Romer*'s Demonſtration; wherefore he has rejected it as ill founded. But there is good cauſe to believe that his motive thereto, is what he has thought not proper to diſcover. And the following Obſervations do ſufficiently ſupply the Defect complained of in the making out of that Hypotheſis.

Anno 1676. *Octob.* 2. *Stil. Nov.* $6^{h.}$ 10'. 37''. *app.* but $5^{h.}$ 59'. 37''. *æq. time*, Monſieur *Caſſini* at *Paris* obſerved the *Emerſion* of the *Third Satellite* from *Jupiter*'s ſhadow.

ſhadow. And again, *Novemb.* 14 following, $6^{h.}20'.55''$. *app. Time*, but $6^{h.}5'.55''$. *æq.T.* he obſerved the like *Emerſion* of the ſame *Satellite*. The obſerved Interval of Time between theſe *Emerſions* was $43^{d.}0^{h.}6'.18''$ which is $8'.22''$. more than 6 mean Revolutions of this *Satellite*, of which $4'.27''$. ariſes from the difference of the firſt Æquations and the greater continuance of the latter Eclipſe; ſo that the other 4 Minutes is all that is left to anſwer for the difference of the ſecond Æquations; and Num. II. in that time increaſing from 48 to 72, gives $4'.36''$. for the difference of the ſecond Æquations of the *Firſt Satellite*. So that here the ſecond Æquation of the *Third* is found rather leſs than that of the *Firſt*, but the difference is ſo ſmall, that it may rather be attributed to the uncertainty of Obſervation. Whereas according to Monſieur *Caſſini's* Method of Calculating, inſtead of four Minutes it ought to be $18'.38''$. and the Interval of theſe two *Emerſions* $43^{d.}0^{h.}21'$. exceeding the Time obſerved by a whole quarter of an hour; which that Curious Obſerver could not be deceived in.

The like appears yet more evidently in the *Fourth Satellite*. By the Obſervation of Mr. *Flamſteed* at *Greenwich*, *Anno* 1682. *Sept.* $24^{o.}\ 17^{h.}45'$. T. app. but $17^{h.}32'\frac{1}{2}$ T. æq. the *Fourth Satellite* was ſeen newly come out of the ſhadow, ſo that about $17^{h.}30'$. T. æq. the firſt beginning of *Emerſion* was conjectured; and after five Revolutions, *viz.* *Decemb.* $17^{d.}11^{h.}16'$. or $11^{h.}18'$. T. æq. he again obſerved the firſt appearance of the *Satellite* beginning to Emerge, that is, after an Interval of $83^{d.}17^{h.}48'$; whereas this *Satellite* makes five mean Revolutions in $83^{d.}18^{h.}25'\frac{1}{2}$. Here we have $37'\frac{1}{2}$ to be accounted for by the ſeveral Inequalities. Of this $21'$ is due to the firſt Æquations, which is reduced to $19'$ by the greater continuance of the latter Eclipſe, *Jupiter* then approaching to his deſcending Node: So that there remains only $18'\frac{1}{2}$ for the difference of the Second Æquations,

tions, whilſt the *Earth* approached *Jupiter* by more than the *Radius* of its own *Orb*; and the difference of the ſecond Æquations of the *Firſt Satellite* being according to *Caſſini* 8′. 30″, the ſaid difference in the *Fourth* ought to be $1^{h.}20'\frac{1}{2}$ inſtead of $18\frac{1}{2}$; whence the Interval of theſe two *Emerſions* would be according to his Precepts, but $83^{d.}\,16^{h.}\,46'$, inſtead of $83^{d.}\,17^{h.}\,48'$. obſerved. And whereas $18'\frac{1}{2}$ may ſeem too great a difference; it muſt be noted, firſt, that Monſieur *Romer* had ſtated the whole ſecond Æquation 22′. 00″, (*vide Phil. Tranſ. Num.* 136.) which Monſieur *Caſſini* has diminiſhed to 14′. 10″; ſo that inſtead of $8'\frac{1}{2}$, Monſieur *Romer* allows above 13′; and ſecondly, that in the firſt of theſe Obſervations, being about half an hour before Sun-riſe, the brightneſs of the Morning might well hinder the ſeeing of this ſmalleſt and ſloweſt *Satellite*, till ſuch time as a good part thereof was emerged.

But I have exceeded the Bounds of my intended Diſcourſe, and ſhall only Advertiſe, That theſe Tables are not Printed with the uſual Care of the *Imprimerie Royale à Paris*, That the *Tabula Revolutionum primi Satellitis Jovis in Annis* 100, *pag.* 13 & *ſeq.* is faulty in theſe Years, 16, 39, 55, 98 & 99; as is alſo the *Epocha* for the Year 1700, *pag.* 99. where *pro Num.* I. 1853 *lege* 1873, and *pro Num.* II. 1004, *lege* 110,4: And that the Number of Revolutions of the Second *Satellite* in 100 Years, *pag.* 60, 61; of the Third, *pag.* 76, 77; and of the Fourth, *pag.* 90, 91, are by a groſs miſtake of the Calculator, all falſe and erroneous, and muſt be amended by whoſoever would uſe them. Which yet ought not in the leaſt to be attributed to the Excellent Author, but rather to the Negligence of thoſe employed by him. The Reader hereof is deſired to amend theſe following *Errata*, which were diſcovered when it was too late.

ERRATA. *Pag.* 238. *lin.* 24. *pro* 5°. 30′. *leg.* 5°. 31′. 40″. *lin.* 25. *pro* 8°. $26'\frac{1}{4}$. *leg.* 8°. $28'\frac{1}{2}$.

III. *A*